Patent application

Device for electrodepositing metallic, prosthetic, molded, dental components

The invention pertains to a device for electrodepositing metallic, prosthetic, molded, dental components, whereby the device has a glass beaker for accommodating an electrolyte bath, a stirring system for moving the electrolyte bath, a heating system for heating the electrolyte bath, at least one anode and at least one cathode, as well as a unit for supplying electricity that is connected to the at least one anode and to the at least one cathode. The invention also pertains to the use of this device and to a process for the manufacture of metallic, prosthetic, molded, dental components via electrodeposition from an electrolyte bath, whereby the electrolyte bath is heated and moved.

Such a device, or such a process, is known from DE 198 45 506 A1. The process, which is also termed an electroforming process, describes the manufacture of prosthetic, molded components for the dental sector via the electrodeposition of metal, especially precious metals and precious metal alloys. The prosthetic, molded components that are manufactured are e.g. dental frameworks onto which ceramic or plastic can be applied in the form of a facing. In addition, molded components are capable of being manufactured that are used in accordance with the double crown technique and the bridge technique, as well as those that find direct use. An aqueous gold sulfite [sic] bath is disclosed here, in particular, as an electrolyte bath for the electrodeposition of the precious metal. The apparatus that is used for carrying out the process

comprises a heated magnetic stirrer for moving the electrolyte bath, a temperature sensor for measuring the temperature of the electrolyte bath, a source of current/voltage, an electrolysis cell comprising a glass beaker with a cover and a stirring rod, as well as the anodes, cathodes and electrolyte bath. During the precious metal deposition process, the electrolyte bath is heated to deposition temperatures of more than 30 °C, and preferably to a temperature in the 50 to 80 °C range.

DE 38 09 435 A1 discloses a device and a process for the manufacture of an inner crown comprising a precious metal for [sic; via?] electrodeposition. The device hereby comprises a bath container with the electroplating bath, a propeller stirrer for moving the bath, a resistance heating coil for heating the bath, an anode, a cathode, an auxiliary electrode, as well as a source of current.

JP 52-089536 discloses the irradiation of an electrolyte with radiation in the 200 through 450 nm range of wavelengths (UV radiation). The electrolyte in this case is a tin bath in which metallic particles of tin are to be dissolved. The UV radiation brings about the removal of the oxide skin on the individual metallic tin particles, and hence improves the dissolution characteristics of these metallic tin particles in the tin bath. The device that is used in this case has a glass container in which the tin bath and the metallic tin powder are located. The tin bath is hereby moved by means of a magnetic stirrer. The UV emitter for irradiating the suspension is located above the surface of the suspension.

US 4,246,086 discloses the manufacture of metallic or ceramic layers via electrophoretic deposition or electrodeposition in order to form dental crowns or dental bridges. An apparatus is disclosed in this case that has a glass or plastic container with an electrophoresis bath or an electrodeposition bath. The bath is hereby moved by means of a magnetic stirrer.

In addition, an electroforming apparatus (Preciano system) and the functional principle of electroforming are known from the publication "Eine konsequente Weiterentwicklung des Galvanoforming-Verfahrens" [A consistent further development of the electroforming process] by the Heraeus Kulzer GmbH & Co. KG company (offprint from DENTAL LABOR, Number 4/1999, Verlag Neuer Merkur [printing company], Munich, authors: Dr. Brämer, Dr. Tertsch, Dr. Schuster, and Messrs. Unkelbach, Raupach, Kimmel, and Schmid). The electroforming apparatus has a transparent glass beaker with a lid through which one leads the cathodes on which the objects, which are to be coated, are arranged. The anode is also led through the lid. The objects that are to be coated are provided with a silver conducting lacquer, and are immersed completely in an electrolyte bath that is moved by means of a magnetic stirrer. A gold bath is hereby disclosed as the electrolyte.

Comparatively long electroplating times are required in order to achieve a molded dental object with an adequate layer thickness by means of electroforming. The molded objects that are formed must also have a homogeneous layer structure, a uniform layer thickness, and adequate strength. High quality requirements are also stipulated for the additional properties of the molded components, such as porosity, wear resistance, corrosion resistance, and aesthetic appearance in regard to gloss and surface quality. Deposition times in the range of many hours

are usually required in order to satisfy all of these requirements. In the case of the known electroforming apparatus, heating of the electrolyte bath takes place via a hot plate that is arranged in direct contact with the electrolyte container. Accordingly, the heating of the electrolyte takes place via thermal conduction, and is correspondingly slow.

The problem for the invention is thus to provide a device and a process for the manufacture of metallic, prosthetic, molded dental components by means of electrodeposition, whereby this device and process lead to shortened deposition times.

The problem is solved for the device by using a heating system that is formed from at least one infrared emitter whose main emission is in the 0.5 μm to 1000 μm range of wavelengths.

Heating of the electrolyte bath by means of thermal radiation is significantly more rapid than heating by means of thermal conduction. In this way, heating times can be achieved that are shorter by a factor of 3 to 5 as a result of using thermal radiation. This is especially important when the deposition times for a molded, dental component are relatively short.

It has proven valuable, in particular, in this way if the at least one infrared emitter is arranged next to the glass beaker, or parallel to the wall of the glass beaker. In addition, it is possible to arrange the at least one infrared emitter above the glass beaker, or over the glass beaker. In this case, attention must be paid to the requirement that the attachment of the anode(s) and cathode(s) in the glass beaker permit access of the radiation to the electrolyte. If the anode(s) and cathode(s) are attached to a lid, which seals the glass beaker, then the at least one infrared emitter can be

integrated into this lid or can be arranged above the lid if this lid is transparent to the thermal radiation.

It has also proven valuable to arrange the at least one thermal emitter below the glass beaker. In this case, the infrared emitter can be combined with a magnetic stirring unit so that stirring movement is possible within the electrolyte bath.

In addition, it is possible to arrange the at least one infrared emitter in the glass beaker, or to integrate the at least one infrared emitter into a wall of the glass beaker. In this case, the infrared emitter can also be immersed wholly or partially in the electrolyte bath.

A further possible form of embodiment of the device is when the at least one infrared emitter encompasses the maximum diameter of the glass beaker. In this case, for example, the glass beaker can be placed in the middle of a coil-shaped infrared emitter. However, an annular arrangement of infrared emitters with an annular cross-section is also conceivable, whereby these infrared emitters are aligned parallel or tangentially relative to the wall of the beaker.

Naturally, it is also possible to combine, in any way with one another, the possibilities that are listed above for positioning the at least one infrared emitter. Attention must merely be paid to the requirement that materials that are located in the path of the rays between the at least one infrared emitter and the electrolyte bath permit the heating of the electrolyte bath.

It has proven especially valuable if the main emission of the at least one infrared emitter is in the 0.5 μm to 4 μm range of wavelengths.

Quartz glass, for example, has proven valuable as the material for the glass beaker. However, attention merely has to be paid here to the requirement that quartz glass is not usually transparent to wavelengths of more than 4 μm, and account must be taken of this in the selection of the infrared emitter and/or its arrangement.

In regard to the manufacturing costs of the device, it has proven valuable if the at least one infrared emitter is suitable for the production of polychromatic radiation. It is also possible, however, to use an infrared emitter that is suitable for the production of monochromatic radiation.

In addition, it has proven valuable to use a magnetic stirrer as the stirring system for the electrolyte bath. However, use can also be made of other stirring systems, such as e.g., motor-driven propeller stirrers, or similar devices.

In addition, it has proven valuable to provide a temperature sensor in order to regulate the electrolyte bath thermostatically. In this case, it has proven valuable to arrange the temperature sensor in the electrolyte bath.

The anode(s) and cathode(s) are advantageously attached to a lid that is suitable for sealing the glass beaker. Rapid and uncomplicated positioning of the objects that are to be coated in the electrolyte bath is possible in this way.

The use of such a device for electrodepositing three-dimensional, metallic, prosthetic, molded dental components is ideal.

The problem is solved for the process by heating the electrolyte bath by means of at least one infrared emitter whose main emission is in the 0.5 μm to 1000 μm range of wavelengths.

Heating of the electrolyte bath by means of thermal radiation is significantly more rapid than heating by means of thermal conduction. In this way, heating times can be achieved that are shorter by a factor of 3 to 5 as a result of using thermal radiation. This is especially important when the deposition times for a molded, dental component are relatively short.

It is especially preferred in this connection if the main emission is in the 0.5 μm to 4 μm range of wavelengths.

It has proven to be valuable in this regard if the at least one infrared emitter emits polychromatic radiation. Use can also be made of an infrared emitter, however, that emits monochromatic radiation.

A precious metal bath is preferably used as the electrolyte bath. Use is made, in particular, of aqueous gold baths in this regard. However, baths for the deposition of precious metal alloys are also preferred.

The following diagrammatic illustrations 1 through 5 will elucidate the invention by way of examples. Thus:

Fig. 1 shows the schematic structure of a known device for carrying out the electroforming process;

Fig. 2 shows the schematic structure of a device in accordance with the invention in which the infrared emitter is arranged above the glass beaker;

Fig. 3 shows the schematic structure of a device in accordance with the invention in which the infrared emitter is arranged below the glass beaker;

Fig. 4 shows the schematic structure of a device in accordance with the invention in which the infrared emitter is arranged next to the glass beaker;

Fig. 5 shows the schematic structure of a device in accordance with the invention in which the infrared emitter is immersed in the electrolyte bath.

Fig. 1 shows the schematic structure of a known device for carrying out the electroforming process, whereby the device has a glass beaker 1 that is filled with an electrolyte bath 2. An anode 3 and a cathode 4a are located in the electrolyte bath 2, whereby a molded component 4b is arranged on the cathode, and whereby the metal from the electrolyte bath 2 is to be deposited on the surface of the molded component 4b. The glass beaker 1 is located on a resistance-heated hot plate 5 in order to heat the electrolyte bath 2. In addition, a magnetic stirrer 6a is provided by means of which a magnetic stirring rod 6b is moved in the electrolyte bath 2, and brings about intensive movement of the electrolyte bath 2. The electrical contacting arrangement for the anode 3 and the cathode 4a, 4b is not illustrated separately.

Fig. 2 shows, by way of example, the schematic structure of a device in accordance with the invention in which an infrared emitter 7 is arranged above the glass beaker 1.

Fig. 3 shows, by way of example, the schematic structure of a device in accordance with the invention in which an infrared emitter 7 is arranged below the glass beaker 1.

Fig. 4 shows, by way of example, the schematic structure of a device in accordance with the invention in which an infrared emitter 7 is arranged next to the glass beaker 1.

Fig. 5 shows, by way of example, the schematic structure of a device in accordance with the invention in which an infrared emitter 7 is immersed in the electrolyte bath 2.

It is explicitly added that other arrangements of one or more infrared emitters are also suitable for heating the electrolyte bath 2, and that these are therefore contained in the thought behind the invention.